Replacing Perchlorate in the M115A2 & M116A1 Simulators

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RDE Command

The Problem

- EPA: Perchlorate is a ‘contaminate of concern’
- ClO_4^- in H_20: Soluble, stable, and persistent
- Increased public concern about perchlorate
- Perchlorate detected at several Army facilities
  - Suspected at many others.
- EPA and States:
  - Proposed Standard – 1 - 4 ppb

COVER STORY

MOVING WEST Water carrying perchlorate gets diverted westward from the lower Colorado River's Imperial Dam, just north of the Mexican border. After passing through the desilitation works on the left, the water enters the All-American Canal.

ENVIRONMENTAL POLLUTION

ROCKET-FUELED RIVER

Lower Colorado carries perchlorate to millions who drink its water, to those who eat lettuce irrigated with its water, and into a tribal well

BY CHERYL HOGUE, C&EN WASHINGTON

ALBERTO RAMIREZ STANDS ON A GREAT EARTHEN DIKE under the relentlessly blazing sun. The dike was built to ensure that when huge storms come, the really big ones anticipated to arrive every 100 years, the water that drains off the mountains won't wash away the development below.

To Ramirez' right is scrubby desert terrain, spotted with low-growing creosote bush, that extends across a plain and up nearby mountains.

To his left, under a brilliant blue sky is the edge of a valley in the southeastern corner of California. Rectangular parcels of green developed land flourish as oases amid undeveloped tracts of desert. A golf course is under construction nearby, and workers wearing wide-brimmed straw hats unroll strips of thirsty turf on the sandy soil. Closer to the dike, with strips of burlap at the trunk, laborers at a nursery dig up the root balls of towering palm trees that will landscape nearby resorts in the Palm Springs area. And just up a gentle slope is a tract of the Torres Martinez Desert Cahuilla Indian reservation with a church and neat collection of one-story houses that are

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The Military's Response

- DOD
  - Perchlorate Working Group
    - Lead: COL Dan Rodgers, USAF
    - Political/regulatory
  - DOD Environmental RDTE:
    - SERDP / ESTCP
    - Perchlorate clean-up & replacement technologies
- Army:
  - AERTA Ordnance Pollution Prevention Program
  - Replacing perchlorate in munitions

Hon. JP Woodley to California SWRCB, July 3, 2003:

"The Army is taking steps to replace perchlorate in two key munitions that account for over 70% of usage in the Army"

Army AERTA P2 Ordnance Program

- Army Environmental Requirements and Technology Assessments (AERTA) Process
  - DA-Level program
  - 4 Working-Level Pillar Tech Teams
    (Compliance, Conservation, Restoration, P2)
  - Requirements developed by “User” Community
  - Technical pgm
    - Developed by Technical Community,
    - Approved by Tech Team
- AERTA: Sole Source of all Official Army Environmental Requirements
    - Many Ordnance-Related Requirements
    - P2 Ordnance Requirement addresses replacing perchlorates

Army AERTA P2 Ordnance Program

Goals

Ensuring that Army operational ranges and munitions production facilities remain available and sustainable in support of the transformation and Future forces.

Pollution prevention in current processes & activities

Leveraging

OSD Advanced Energetics Program

Army Munitions Mission Programs

7 Thrust Areas

- Current Non-Energetic Materials and Manufacturing Processes
- Energetic Materials/New Molecules
- Rocket/Missile Propellants
- Primers/Initiators/Fuses
- Gun Propellants
- Explosives
- Pyrotechnics

Perchlorate Usage In Munitions

- Perchlorate is a GREAT Oxidizer (ClO4-)
- Ammonium Perchlorate (AP)
  - Rocket and Missile Propellant
  - More sensitive than KP
- Potassium Perchlorate (KP)
  - Simulator, delay, incendiary, illumination, gas generator, and tracer compositions
- “70%” of the Army’s Usage in 2001 was in two items:
  - M115A2 Ground-Burst Projectile Simulator
  - M116A1 Hand Grenade Simulator
- Projected to be ~36% of the usage from FY05-09
  - Usage and potential for contamination significant

Uncertainties: Usage vs. Purchases*

Munition Type	Planned Purchases	Tons of Perchlorate
Missiles	1,804	700
M115A2	1,551,657	64
M116A1	1,263,736	26
All Others	42,093,072	150
Non-Perchlorate Items	4,003,549,972	0

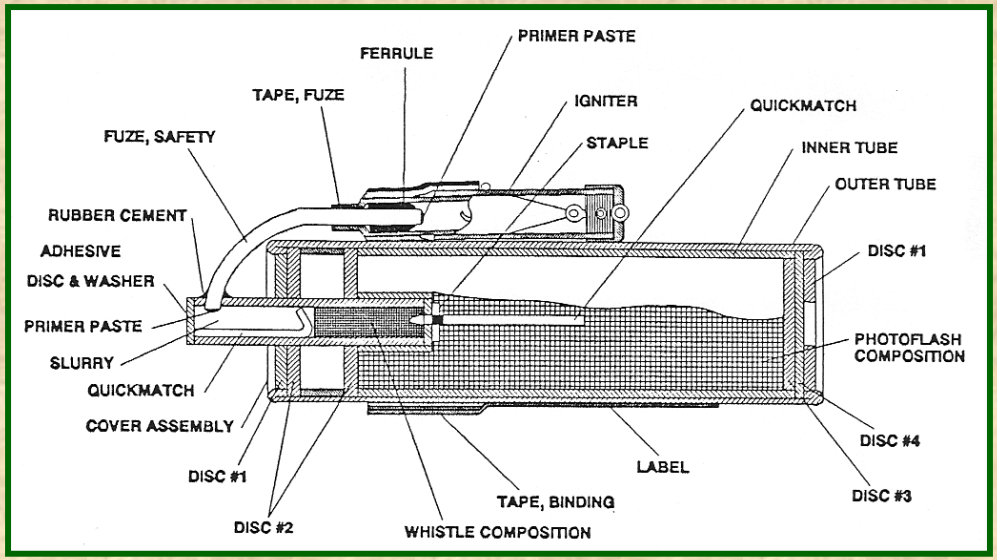
* Based on purchases planned in FY05-09 POM

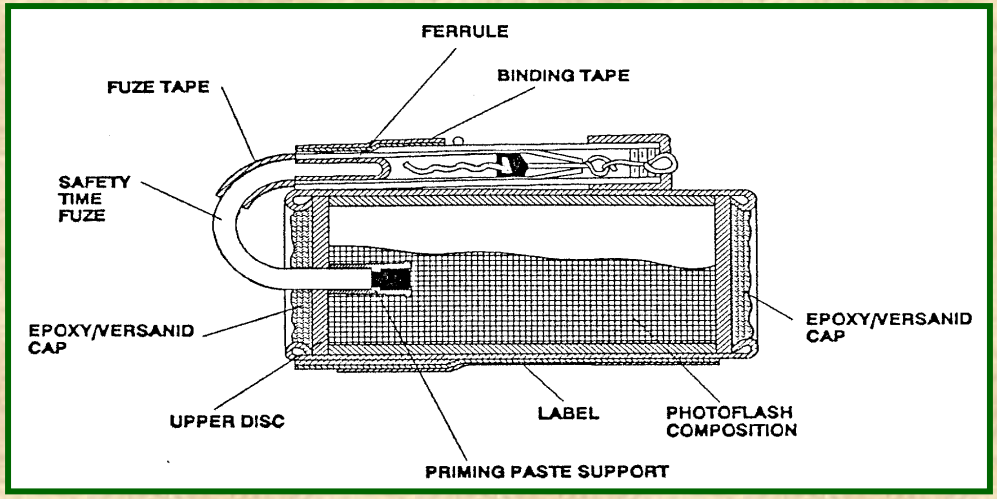
Program Objectives

- Develop, demonstrate & implement perchlorate-free propellant & pyrotechnic compositions
- Must:
  - Perform equally or better than current munitions
  - Have no apparent change in function or size to the end user
  - Present minimal/no impact on the environment or human health.
  - A true “drop-in” replacement
- Initial focus on the low-hanging fruit:
  - M115A2 Ground Burst Projectile Simulator (DODIC - L594)
  - M116A1 Hand Grenade Simulator, (DODIC - L601)
- Long-term will address other high-usage, high-production items

What is a Simulator?

M115A2/M116 SYSTEM HARDWARE CONFIGURATION





M115A2 Ground Burst Simulator

- ✓ ***Hand-thrown device***
- ✓ ***Simulate battle noises and effects (shells in flight & ground explosions) during troop maneuvers (on land only)***
- ✓ ***Produce whistling, flash, and loud report***

M116A1 Hand Grenade Simulator

- ✓***Hand-thrown device***
- ✓***Simulate battle noises and effects during troop maneuvers (on land only)***
- ✓***Produce flash and loud report***

Project Scope

- Flash-bang compositions in both simulators will be replaced
  - 40.0 grams per M115A2
  - 20.0 grams per M116A1
- Whistle composition in the M115A2 may be replaced
  - Depends on performance of new composition
  - Additional 2.0 grams per item

The Team

- OSD – policy guidelines
- HQDA – policy, funding, and implementation
  - DASA(ESOH)
  - ASA(ALT) (ESO)
- AMC / PMs – Integration, LCCA, Item Management, and Demilitarization
- AEC – AERTA / Functional and Operational Analysis
- RDECOM – Program Management
- ECBC / ARDEC - Lead Technologists
- Grucci – Current Manufacturer

Project Approach: Phase I

- Development of a Replacement Composition
  - Two teams developing candidate replacements
    - Edgewood Chemical Biological Command
      - Lead: Mr. Joseph Domanico
      - Searching for an Organic-based composition
    - Armaments Research, Development, and Engineering Center
      - Lead: Mr. James Wejsa
      - Searching for an metallic-based composition
      - Sponsored by PM Close Combat Support
        - » Product Improvement Program

Project Approach: Phase I (Cont.)

- Proof of Principal Demonstration
  - Candidate compositions evaluated/screened for
    - Size, weight, flash, noise, environmental impacts, and safety.
    - Manufacturability and transparency to the user
- Downselect: July 2004
  - Final candidates selected and initial hazard classification performed (IHC)

Project Approach: Phase II

- Demonstration, Validation, and Testing
  - 2 candidates will go through Phase II
  - New composition must
    - Meet system baseline and functional requirements
      - Mil-S-10057H, MIL-S-10058H
      - Associated drawings
    - Meet subjective requirements
      - Size, weight, shape, fragmentation and feel
    - Not require a change in manufacturing process
  - Energetic Material Qualification Board (EQMB) tests

Project Approach: Phase II (cont.)

- Demonstration, Validation, and Testing (cont.)
  - Final Hazard Classification (FHC) tests
  - Environmental and Health Assessments
    - ECBC Coordinates with CHPPM
- Downselect: 3rd Quarter FY05
  - Final Composition

SYSTEM BASELINE & FUNCTIONAL REQUIREMENTS

System	Performance Requirements	Current Composition	
M115A2 Simulator **Projectile, Ground Burst** **DODAC: 1370-L594** **DOT: Explosive B** **(PN: 7549246)**	***Delay after Ignition*** ▪ **Whistle: 6-10 sec** ▪ **Burst: 8-14 sec** ***Burning Time*** ▪ **Photo Flash: Instantaneous** ▪ **Whistle: 2-4 sec** ***Sound Level*** ▪ **138 decibels min at 75 feet** **(Mil-S-10058H)**	***Whistle Composition(2 gm)*** ***(PN:7549227)*** **Sodium Salicylate (28%)** **Potassium Perchlorate (69%)** **Red Gum (3%)** ***Flash Composition (40 grams)*** ***(PN: 12972326)*** **Aluminum (flaked) 42.5%** **Potassium Perchlorate (57.5%)** ***Ignition System*** ▪***Fuse Igniter Charge (41 mg)-M3A1*** ***(PN:8833721)*** **Potassium Chlorate (88%)** **Charcoal (10%) Dextrin (2%)** ▪***Fuse End Primer -9256477*** ▪***Safety Fuse (3 1/4" by 3")-9345154*** ▪***Quick Match (1 ½", Type 2, Cl A, Mil-G-378)***	
M116A1 Simulator **Hand Grenade** **DODAC: 1370-L601** **DOT: Explosive B** **(PN: 9256467)**	***Delay after Ignition*** ▪ **Burst, 6 to 12 sec (acceptance 8.5 sec min)** ***Burning Time*** ▪ **Photo Flash: Instantaneous** ***Sound Level*** ▪ **125 decibels min at 75 feet** **(Mil-S-10057H)**	***Flash Composition (20 grams)*** ***(PN: 12972326)*** **Aluminum (flaked) 42.5%** **Potassium Perchlorate (57.5%)** ***Ignition System*** ▪***Fuse Igniter Charge (41 mg)-M3A1*** ***(PN:8833721) See above composition*** ▪***Fuse End Primer -9256477*** ▪***Safety Fuse (" by ")-9345154***	

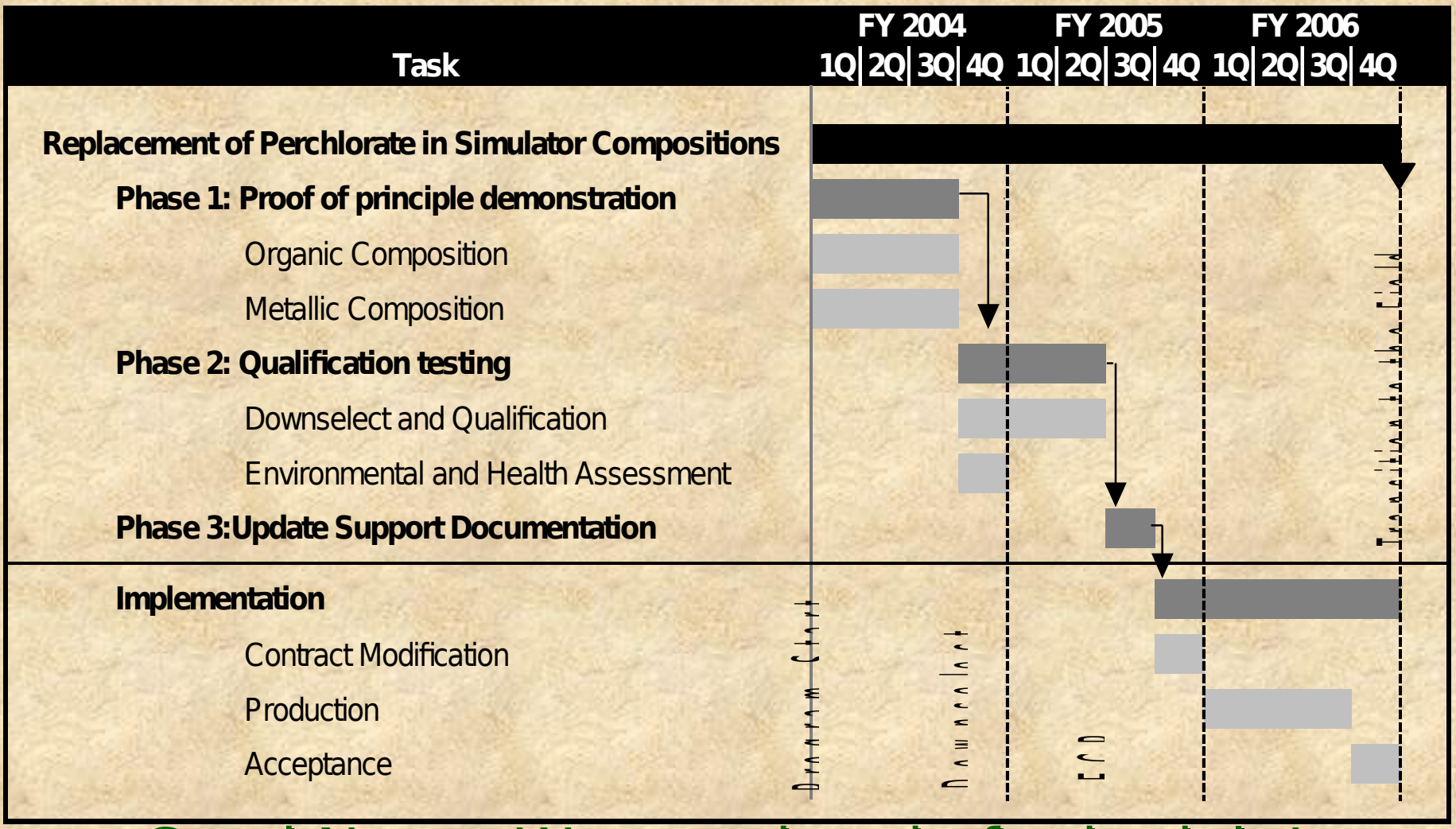
Project Approach: Phase III

- Document Changes
  - Engineering Change Proposal (ECP) for Specification/Drawings
  - Change Technical Data Package for Manufacturing
- Final Implementation
  - Incorporate now composition into production
  - Monitor production
  - Conduct acceptance testing
  - Transition to the field.

The Risks

- Cost
- Performance characteristics
- Manufacturability
- Testing Schedule
  - Manufacturer’s Availability
  - Balance between PIP and Production Schedules
- ‘Green Bullet’ syndrome
- Risks reduced by developing two candidates

The Timeframe



Good News: We are ahead of schedule!

Summary

- Will replace the #1 sources of perchlorate contamination risk on ranges
- On track to finish 5 months ahead of original schedule
- Army Ordnance P2 program is working to replace perchlorate in higher volume, life-cycle risk items
- Results, lessons learned of this program will be leveraged on other projects